DESCRIPTION OF THE LARVA AND PUPA OF CANTHOCHILUM HISTEROIDES (HAROLD) WITH NOTES ON ITS BIOLOGY (COLEOPTERA: SCARABAEIDAE)

By Eric G. Matthews[1, 2]

Canthochilum histeroides (Harold) is one of five described species of dung beetles of the subtribe Canthonina (tribe Scarabaeini, or ball rollers) occurring in Puerto Rico. All five species are endemic to Puerto Rico or the Greater Antilles and are the only Scarabaeinae known to occur in Puerto Rico. The Antillean Canthonina are currently under taxonomic revision by Father Francisco Pereira of the Secretaria da Agricultura, São Paulo, Brazil.

The area in which this species was investigated is a portion of the northern slope of the mountain known as El Yunque in the Luquillo National Forest, Puerto Rico. The vegetation consists of tropical rain forest, considerably disturbed by man. Two additional species of Canthonina were collected abundantly in this area: *Canthochilum hispidum* Chapin and *Canthonella pygmaea* (Harold), but no larvae of these two species have yet been obtained. It is quite evident that these three species are strictly adapted to rain forest leaf-litter conditions, as they are not found even in adjacent cow pastures. All three may occur together in one location in the rain forest, but usually one species predominates, often to the complete exclusion of the other two. Each of the three species predominates in at least one area studied. *C. histeroides* is generally the most abundant. I have observed all three fashioning dung into balls and rolling it, in the manner typical of Scarabaeini.

C. histeroides buries the dung balls that are to serve as larval food individually 7-10 centimeters directly below the dung supply. Only brood balls several weeks old were seen; no trace of a burrow could be seen at that time. The brood balls measure 7 × 8 to 9 × 11 millimeters, with the longer axis vertical; they are smoothly contoured on the lower half but rough on the upper, probably as a result of the activities of the larva. The brood ball is made of dung with an outer crust of clay soil, which varies greatly in thickness.

Larvae were obtained only on 6 June 1962, and 10 April 1963, in spite of continuing attempts throughout the year. This seems to indicate a reproductive season, consonant with the period of slightly increased rainfall. Pupae were found as little as 36 days after the deposition of the dung supply, indicating a life cycle of around 40-50 days, which is remarkably short for a scarabaeine dung beetle.

Cow dung was used in this study. Normally cow dung is not present in the rain forest and I do not know what type of dung is ordinarily fed

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upon. The only mammals present in the forest are rats (*Rattus* sp.), bats, and man. That the food supply must be very plentiful is shown by the apparent abundance of these beetles. Traps overnight normally yield an average of 18 individuals, counting all three species; one 10 ounce can, after being left overnight, contained 93 individuals, all *C. histeroides*. This species is nocturnal.

Methods

Larvae were collected by burying 46-oz. cans, the bottoms of which had been perforated, in the soil up to the rim, and by filling the cans with soil and a quantity of cow dung on top. These traps were set at intervals along an ascending road in the Luquillo National Forest in May, June, August, and September, 1962, and February, 1963. The cans were collected after about a month and the soil was checked for brood balls. Seventeen balls were found in one can on 6 June 1962 and were broken open. Fourteen balls contained third-instar larvae (inferred because of their size and the fact that the dung supply in the ball was almost gone) and three contained pupae. Seven larvae and two pupae were preserved, the remainder being allowed to develop to maturity in the laboratory. All the adult beetles thus obtained (between 15 and 21 June) were *C. histeroides;* there is thus reasonable certainty of the identity of the larvae. A single additional larva found in the same location on 10 April 1963 was preserved.

Larvae and pupae were killed in Peterson's fluid and thus fixed for about a day, then transferred to 70% alcohol. Two heads and two sets of mouthparts were mounted on slides and cleared in modified Berlese insect mounting medium. Measurements were made with the use of an ocular micrometer.

The terminology used in the following description is from the comparative study of Oberholzer (1959), which in turn largely follows current American usage based on the works of Bøving. Europeans do not use this terminology, which involves primarily the epipharynx, hence their descriptions are of little use for comparative purposes.

The descriptions are based on the following material: Seven third-instar larvae and two pupae collected in dung trap at Km. 9.7, Route 191, Luquillo National Forest, Puerto Rico, 6 June 1962, altitude 1800 feet; one third-instar larva collected in the same locality on 10 April 1963. (Abbreviations in parentheses refer to abbreviations used in illustrations.)

Description of Larva
(Figs. 1-5)

Body strongly doubled with a prominent transverse ridge ("wart") on third abdominal tergite; pronotum without lateral processes; body bare except for two transverse rows of long, sparse setae on each annulet of terga. Total length 7.35-7.55 mm.

Width of head capsule 1.32-1.42 mm.; epicranial suture (eps) continued frontally beyond fork of frontal suture (fs), but without supplementary Y-shaped depression; dorsoepicranial setae (des) two; lateral epicranial setae (les) in two unequal pairs; posterior frontal setae (pfs) two; anterior frontal setae (afs) two, exterior frontal

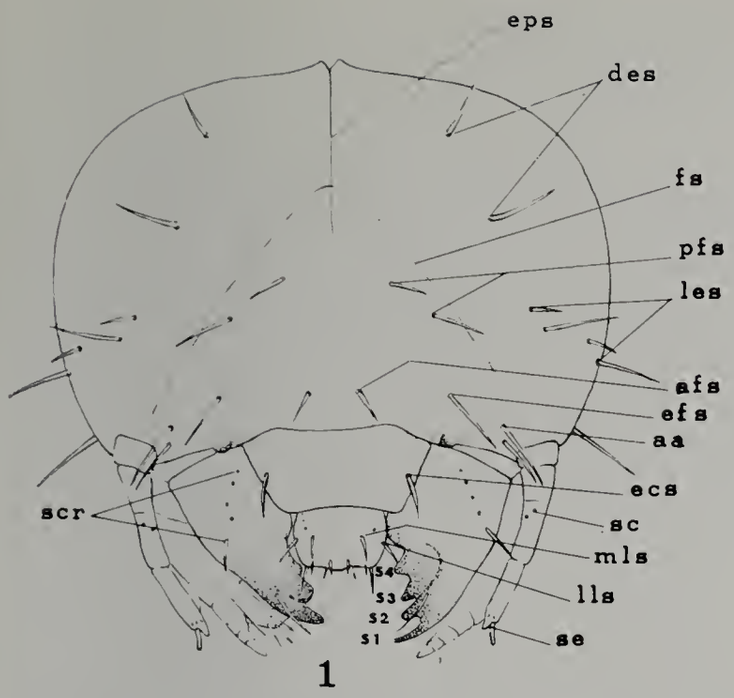
setae (efs) two, and two setae in each anterior frontal angle (aa) (counting one side only in all cases). Antennae four-segmented, but with the basal two segments nearly fused and not articulated; second segment bearing two sense organs of the type called sensilla coeloconica (sc) by Landin (1961); third bearing apically a sensory cone (se) half as long as fourth segment, which is minute. Clypeus with but two exterior setae (ecs). Labrum symmetrical, weakly trilobed, with two paramedian setae (mls) and two lateral setae (lls), plus eight setae on the distal edge. Epipharynx with haptolachus bearing two or three macrosensilla (ms), with a continuous, sinuate mesophoba (mph) which is polystichous on the right side, and a diffuse crepis (cr); tormae united mesally, short asymmetrical anterior (aet) and posterior (pet) epitormae present, apotorma absent; dexiotorma with a long pointed pternotorma (ptt), the left pternotorma very lightly sclerotized; pedium bare, with complete dexio-, laeo-, and protophoba (ph) consisting of close-set filaments, those of protophoba bifurcate; haptomerum (hm) devoid of definite heli, but with three or four small sensilla; chaetopariae (cp) with two or three setae, acropariae (acr) with three stout bristles, and acanthopariae (acp) with one very long bristle; corypha (co) with a row of four short, stout bristles; clithra lacking. Left mandible with scissorial region bearing S1-4 distinct and separate; distal lobe of molar region acute and simple; brustia of many setae; dorso-molar setae absent; one very small ventro-molar seta tuft; scrobis (scr) consisting of one long distal seta and four tubercles in a row; stridulating area not seen. Right mandible with scissorial region showing S1-3 separate and distinct, molar region devoid of teeth, brustia with only two or three bristles, and two ventro-molar tufts; otherwise like left mandible. Maxillae with subdivisions of cardo (car) not clearly differentiated; labacoria (lc) with fine, close-set tuberculation; stridulatory teeth of stipes (str) small, conical, six in number, set in an irregular row; palpus (mp) short, tapering; lacinia (lac) and galea (ga) separated, bearing a number of stout bristles; lacinia with two unci (un), the proximal one setiform, galea with a single terminal uncus (un). Hypopharyngeal sclerite (=oncylus) (hsc) complex, with a strong, blunt dextral projection. Arrangement of setae on glossa as indicated in fig. 3; proximal segment of labial palpus (lp) very short, distal segment subcylindrical, with a cluster of terminal sensilla basiconica.

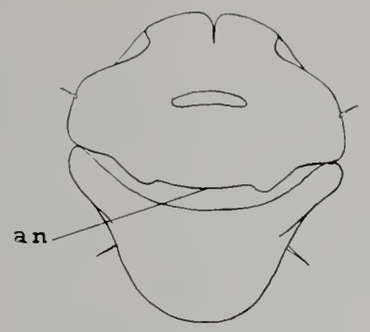
Legs devoid of claws, tarsus bearing a terminal papilla which is surrounded basally by four to six setae and which bears two setae terminally. Legs three-segmented.

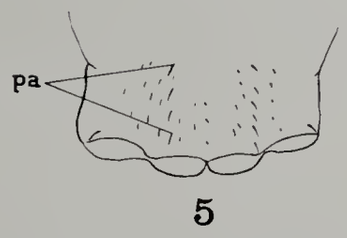
Raster with palidia (pa) consisting of two longitudinal, monostichous rows of blunt setae only slightly larger than other setae, which are scattered sparsely in between and on both sides of palidia on venter of tenth abdominal segment.

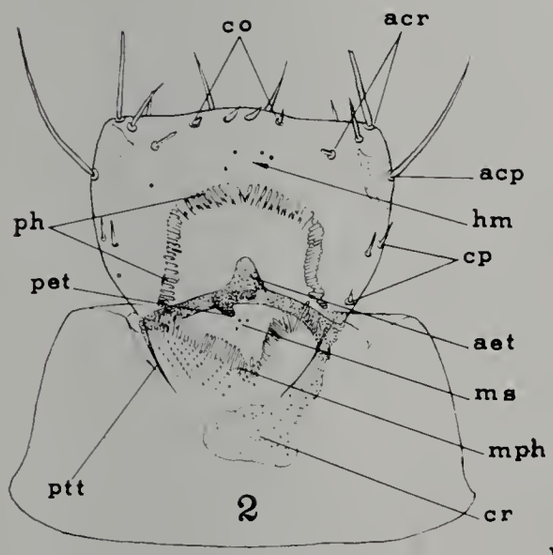
Anal slit (an) transverse and of a peculiar shape, with two angulations on the ventral lip; a long, curved transverse depression dorsal to anal slit and a short elongate-oval transverse depression in center of ventral area; ventral border with three lobes, of which the median is cleft.

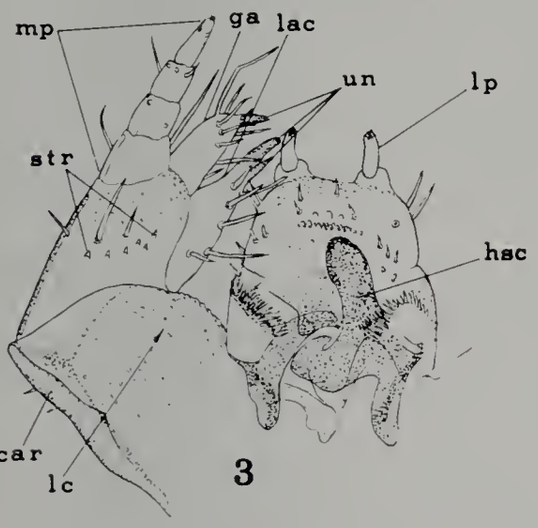
SYMBOLS: aa—Setae of anterior frontal angle. abd 3-5—Appendages of abdominal segments 3-5. acp—Setae of acanthopariae. acr—Setae of acropariae. aet—Anterior epitorma. afs—Anterior frontal setae. an—Anal slit. ant—Antenna. ca—Caudal appendage. car—Cardo. co—Setae of corypha. cp—Setae of chaetopariae. cr—Crepis. des—Dorsoepicranial setae. ecs—Exterior clypeal seta. efs—Exterior frontal setae. els—Exterior labral seta. eps—Epicranial suture. fs—Frontal suture. ga—Galea. gen—Developing genitalia. hm—Haptomerum. hsc—Hypopharyngeal sclerite (=oncylus). lac—Lacinia. lb—Labium. lc—Labacoria. lls—Lateral labral seta. lp—Labial palpus. md—Mandible. mls—Median labral seta. mp—Maxilliary palpus. Mph—Mesophoba. ms—Macrosensilla of haptolachus. mx—Maxilla. pa—Palidium of raster. pet—Posterior epitorma. pfs—Posterior frontal seta. ph—Phobae. pp—Pronotal prominences. ptt—Pternotorma. S1-4—Scissorial teeth of mandible. sc—Sensilla coeloconica. scr—Scrobis. se—Sensory cone of antenna. str—Stridulatory teeth of stipes. un—Unci. wp—Wing pads.

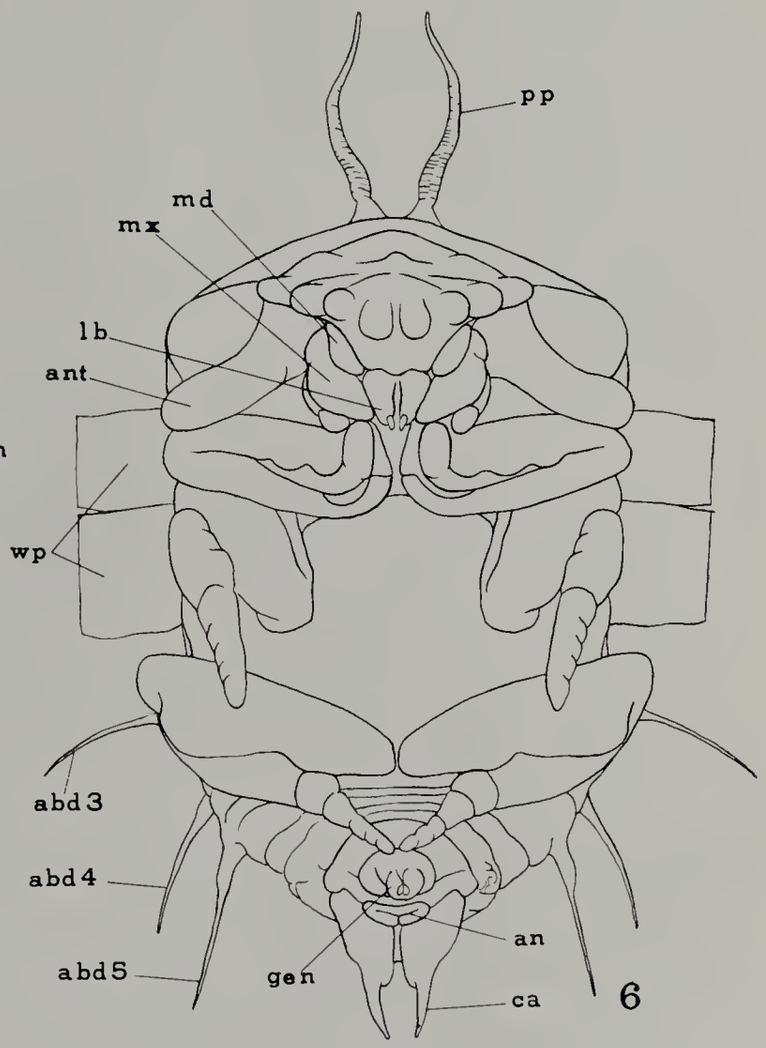












FIGURES 1-6. Larva and pupa of *Canthochilum histeroides* (Harold). 1—Head of larva, anterior view. 2—Epipharynx of larva. 3—Left maxilla and labium of larva, anterior view. 4—Anal area of larva with ventral side up. 5—Venter of tenth abdominal segment of larva. 6—Pupa, with wing pads cut off, ventral view.

Description of Pupa
(Fig. 6)

In view of the absence of a systematic basis in the literature for discussing pupal characters in the Scarabaeidae, it seems best at this time to confine the description of the pupa to a presentation of the illustration (fig. 6). Attention is called merely to the long filaments which are located as follows: two approximated median pronotal projections (pp), a pair of lateral filamentous projections issuing from each tergum of abdominal segments 3, 4, and 5 (abd 3, 4, 5) and a pair of terminal caudal filaments (ca) issuing from the anal lobes. Total length of the pupa (including caudal filaments) is 3.51-4.54 mm.

Discussion

Our knowledge of scarab larvae, although advancing, is still very fragmentary. In the Canthonina, only two other species have been properly described, to my knowledge: *Canthon pilularius* (L.), described by Hayes (1930) and Ritcher (1945), and *Deltochilum gibbosum* (F.), described by Howden and Ritcher (1952). The larva of *Deltochilum brasiliense* Laporte has been described by three European authors, but for reasons previously mentioned their descriptions are not usable.

The larva of *Canthochilum histeroides,* described above, differs in the following respects from both *Canthon pilularius* and *Deltochilum gibbosum:* A distinct wart is present on the dorsum of the third abdominal segment (as in *Onthophagus,* according to Ritcher (1945)), the processes of the prothoracic shield are absent (as in *Onthophagus* and *Ateuchus*), the chaetopariae have only two or three bristles and the mesophoba is dextrally polystichous (both as in *Copris, Onthophagus,* and *Ateuchus*), the tormae are asymmetrical with the right pternotorma nearly absent (as in *Ateuchus*), and the palidia are monostichous (as in *Ateuchus*). It further differs from *Canthon* in that the stridulatory area of the maxilla has far fewer teeth, the uncus of the lacinia has a proximal tooth, the median anal lobe is cleft, and the tarsus has two terminal setae. In the last four respects *Canthochilum* resembles *Deltochilum,* so we may consider the larva of this genus to be somewhat closer to that of *Deltochilum* than to that of *Canthon* (without being really close to either). It is interesting to note that Chapin (1934) observed a number of adult similarities between *Deltochilum* and *Canthochilum* when he was describing the latter, and this undoubtedly prompted his choice of a generic name.

The larva here described agrees with Ritcher's (1945) characterization of scarabaeine (=coprine) larvae in all but two respects: the scissorial areas of both mandibles have S1 and S2 separate, and the legs are three-segmented, the femur and tibiotarsus articulating freely. Both conditions appear to be more primitive than what we see in other scarabaeine larvae. However, there seems to be some confusion about the exact number of leg segments in different genera: Paulian (1945), in his key to scarab larvae, distinguishes between *Copris* and *Onitis* on one hand, and *Oniticellus*

and *Onthophagus* on the other, by stating that the former pair of genera have the "pattes triarticulées"; and Oberholzer (1958), in describing the larva of *Onitis caffer* Boheman, states that the leg is two-segmented, the trochanter, femur, and tibiotarsus being fused. In any case, the leg of *Canthochilum* is quite clearly three-segmented. The larva of *Canthochilum* shares isolated characters with no less than five unrelated genera of Scarabeinae and shows two unique primitive characters. This indicates that *Canthochilum* may be in a key position in larval phylogeny. The primitive nature of the smaller Canthonina has long been recognized by students of the coprophages, and the need for larval studies has been expressed by Paulian (1945) in reference to the Canthonina and "Panelini."

With regard to the pupa, the prominent filaments merit some discussion. It has been known for some time that the pupae of Scarabaeinae are characterized by the presence of protuberances, at least on the abdomen, and that these serve to isolate the pupa from all direct contact with the dung or earth walls of the brood ball (Paulian, 1949, p. 1024). The filaments of *Canthochilum* are in exactly the same location as the bumps on the pupa of *Deltochilum brasiliense* Castelnau, for instance, as illustrated in von Lengerken (1955), and may be considered to be extensions of these bumps. In no other scarabaeine pupa yet described, however, are these protuberances filamentous. In the Aphodiinae, the caudal projections are filamentous (Paulian, 1945, and Jerath, 1960, both citing Gardner) and this is supposed to distinguish aphodiine pupae from all other scarabs.

A survey of the shape and location of pupal protuberances and stigmata in the Scarabaeinae will form the subject of a separate study.

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BOOK REVIEW

THE CHRYSOMELIDAE (COLEOPTERA) OF CHINA AND KOREA, PART 2. By J. L. Gressitt and S. Kimoto. B. P. Bishop Museum, Honolulu, pp. 300-1026, figs. 78-284 (incl. 1 color plate). 1963. ($10.00.)

This large volume completes the taxonomic and distributional study of known kinds of leaf beetles occurring in the Chinese area, spanning portions of both the Oriental and Palearctic regions. The Palaearctic elements represented include the Manchurian and the Central Asian subregions. Many leaf beetles of Taiwan are not included in this study, because they are being separately monographed by Professor Chûjô.

Part 1 (in 1961) dealt with 17 subfamilies of leaf beetles, but only five are covered here. These are Chrysomelinae (191 species), Galerucinae (531 spp), Alticinae (307 spp), Hispinae (116 spp), and Cassidinae (96 spp). For each species, there is a complete list of synonyms and a summary of the known geographical and ecological distributions. There are excellent keys for the separation of all known Chinese genera and species, dozens of genitalic drawings, and hundreds of beautiful illustrations of adults, larvae, and pupae. In all, 175 new species are described in Part 2, in addition to the 68 already described in Part 1. The beetles treated are from all parts of China, but material from the southern regions predominates.

The Summary includes brief tabulations of the geographical distribution of all subfamilies, genera, species, and subspecies, and clarifies many details concerning geographic place-names that might otherwise be confusing to foreign entomologists. The extensive Index deserves special mention also, because it specifies which names are synonyms, which are new species, and, whenever a species name occurs more than once, what are the generic affiliations of each citation.

Throughout the book meticulous attention has been devoted to the detailed locality records, dates, collector references, and indications of present deposition of the specimens cited.

This remarkably thorough monograph should be in the library of every serious entomologist and will be especially essential for active coleopterists. The extensive distribution of many of the genera treated here will often permit practical use of the keys by persons studying leaf beetles in regions rather remote from China. It is a pleasure to praise this worthy addition to entomological literature, and it is hoped that the interest and favorable response of our colleagues will encourage additional accomplishments of this monumental nature in the future!—J. GORDON EDWARDS, San Jose State College, San Jose, Calif.

Ricksecker often tethered female beetles, like *Prionus,* to a fence with a silk thread in order to capture the males which were thus attracted.—Essig, 1931, A History of Entomology.